

Use of Tablet (iPad®) as a Tool for Teaching Anesthesiology in an Orthopedic Rotation

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Summary: Tanaka PP, Hawrylyshyn KA, Macario A – Use of Tablet (iPad®) as a Tool for Teaching Anesthesiology in an Orthopedic Rotation.

Background and objectives: The goal of this study was to compare scores on house staff evaluations of “overall teaching quality” during a rotation in anesthesia for orthopedics in the first six months (n = 11 residents were provided with curriculum in a printed binder) and in the final six months (n = 9 residents were provided with the same curriculum in a tablet computer (iPad, Apple®, Inc, Cupertino, Ca)).

Methods: At the beginning of the two-week rotation, the resident was given an iPad containing: a syllabus with daily reading assignments, rotation objectives according to the ACGME core competencies, and journal articles. Prior to the study, these curriculum materials had been distributed in a printed binder. The iPad also provided peer reviewed internet sites and direct access to online textbooks, but was not linked to the electronic medical record. At the end of the rotation, residents anonymously answered questions to evaluate the rotation on an ordinal scale from 1 (unsatisfactory) to 5 (outstanding). All residents were unaware that the data would be analyzed retrospectively for this study.

Results: The mean global rating of the rotation as assessed by “overall teaching quality of this rotation” increased from 4.09 (N = 11 evaluations before intervention, SD 0.83, median 4, range 3-5) to 4.89 (N = 9 evaluations after intervention, SD 0.33, median 5, range 4-5) p = 0.04.

Conclusions: Residents responded favorably to the introduction of an innovative iPad based curriculum for the orthopedic anesthesia rotation. More studies are needed to show how such mobile computing technologies can enhance learning, especially since residents work at multiple locations, have duty hour limits, and the need to document resident learning in six ACGME core competencies.

Keywords: Computers, Handheld; Education, Medical, Graduate.

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INTRODUCTION

A tablet is a portable personal computer with a touchscreen and wireless access to the Internet, designed to be operated by an individual¹. Clinicians have adopted tablet computers in conjunction with electronic health record use. Tablet computers have been studied for physician use in the examination room², surveying parents of hospitalized children to assess communication by the medical team³, and assessing patient symptoms^{4,5}. Some preclinical medical students have found the iPad (Apple®, Inc) effective for note taking and as a study tool⁶. In addition, some medical journals are available as an application for iPad⁷. While there have been some studies of utilizing tablets in areas of teaching outside graduate medical education⁸, little is known about how mobile computing

can help deliver a curriculum to anesthesia residents. Many of these residents belong to the Millennial generation, those born between 1982 and 2001, who do not know a world without computers, Internet, or cell phones. Sixty-eighth percent of Stanford anesthesia residents own a cell phone with data service⁹. Millennials interact with the world in a fundamentally different way than previous generations. They express a preference for the use of technology and just in time learning¹⁰.

The goal of this study was to compare scores on house staff evaluations of “overall teaching quality” during a rotation in anesthesia for orthopedics in the six months before (n = 11 residents were provided curriculum in a printed binder) and in the six months after (n = 9 residents) receiving the same curriculum content in a tablet computer (iPad, Apple®, Inc, Cupertino, Ca). The tablet provided continuous availability of a shared visual portfolio with suggestive and varied topics for discussion. It was intended to serve as a tool for both self-directed learning outside the operating room (OR) and to facilitate a dynamic discussion inside the OR between the attending and the resident.

METHODS

This study was approved as Exempt by the Institutional Review Board, as this study analyzed existing rotation evaluation data without identifiers linked to the residents.

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Table I – Evaluation of Rotation Before and After new iPad® Curriculum

	Prior to iPad® (n = 11) Mean (SD, median, range)	After iPad® (n = 9) Mean (SD, median, range)
The goals of the rotation were defined	3.73 (0.90, 4, 2-5)	4.89 (0.33, 5, 4-5)*
The goals of the rotation were achieved	3.82 (0.98, 4, 2-5)	4.67 (0.50, 5, 4-5)
Quality of the syllabus	3.82 (0.87, 4, 2-5)	4.78 (0.44, 5, 4-5)*
Were the cases of educational value	4.00 (0.77, 4, 3-5)	4.67 (0.71, 5, 3-5)
Clinical teaching	4.27 (0.79, 4, 3-5)	4.78 (0.44, 5, 4-5)
Teaching not directly involved with case	3.70 (0.95, 4, 2-5)	4.78 (0.67, 5, 3-5)*
Feedback provided	4.27 (0.65, 4, 3-5)	4.78 (0.44, 5, 4-5)
Overall teaching quality of this rotation	4.09 (0.83, 4, 3-5)	4.89 (0.33, 5, 4-5) (p = 0.04)

SD: standard deviation; *p < 0.05.

Starting on August 1st, 2010, at the beginning of the two week anesthesia for orthopedics, the resident was given an iPad based curriculum. One resident was on the rotation at a time, which was focused mainly on hip and knee joint arthroplasty surgeries.

The iPad had a syllabus containing 21 core articles, a collection of other articles on a variety of topics to be used as needed, a daily schedule of reading assignments for the resident, a faculty checklist for tasks for each day (e.g., feedback), Accreditation Council for Graduate Medical Education (ACGME) core competency based rotation objectives, and three different problem-based learning case slide presentations. Prior to the study, the same curriculum materials were distributed in a printed binder. The goals of the rotation were presented in exactly the same way, except for the only difference of being presented through an iPad instead of on paper.

The iPad also provided quick access to pre-selected peer reviewed internet sites and direct access to online textbooks. The iPad was not linked to the hospital's electronic medical record. It was available throughout the two-week rotation to residents in the OR and to bring home. No specific training was provided on how to use the iPad.

At the end of the rotation, each resident submitted a slide software presentation seeking to address a clinical question they encountered, a literature review, or any content they thought relevant, including related to the ACGME core competencies, which was saved on the iPad. The iPad therefore provided an electronic portfolio with content generated by each resident for use by future residents on the rotation.

After the rotation, as with all rotations in our training program, each resident evaluated the rotation by answering eight questions. Answers were on an ordinal scale, meaning that the relative degree of difference between the items was not measured: unsatisfactory (score = 1), below average (score = 2), at expectation (score = 3), above expectation (score = 4), outstanding (score = 5). These quantitative evaluation scores were completed anonymously via the institution's residency online software (<http://www.medhub.com/>). Free text comments were also written by residents. The residents were unaware that data would be analyzed retrospectively for this study.

The sample size calculation assumed $\beta = 0.8$, $\alpha = 0.05$, a pre-intervention rotation score of 4.0 (SD 0.6) out of maximum

five, with an increase of 0.75, for an effect size = 1.25. The estimated needed sample size equaled eight in each group.

Since the primary hypothesis of study was that the scores for "overall teaching quality of this rotation" would increase, the answer data for this question for the six months before introduction of the iPad curriculum were compared using the Wilcoxon signed-rank test with the scores for the six months after introduction of the iPad curriculum.

RESULTS

During the six months prior to the introduction of the new curriculum via iPad, 11 resident evaluations were completed. During the six months after the introduction, 9 resident evaluations were completed.

On a scale from 1 (unsatisfactory) to 5 (outstanding), the mean global rating of the rotation as assessed by "overall teaching quality of this rotation" increased from 4.09 (SD 0.83) to 4.89 (SD 0.33) p = 0.04 (Table I).

For the other sub-dimension items, the largest positive increases were for "Goals of the rotation were defined", "Teaching not directly involved with case management", "Quality of the syllabus", and "Goals of the rotation were achieved".

A sample of the written comments included: "Strong effort to provide us with reading material through the iPad"; "The iPad syllabus and readings were impressive, it was a great way to organize the teaching for the rotation and I felt it was a really helpful learning toll"; "The iPad is really helpful, great 'ortho' curriculum and teaching, it is very organized and allows maximal amount of learning during the two week rotation"; "Outstanding syllabus, and what is more impressive is that the goals were taken seriously and we reviewed them almost daily to make sure they were being met".

The main drawbacks of the tablet cited for future improvement by the house staff included the unavailability of Flash® applications, and the inability to take notes easily.

Suggestions for content improvement included the addition of a question bank, ACLS algorithms, weight based dosing protocols, and a resident generated content rating system, allowing the highest yield aspects of the curriculum to be identified.

DISCUSSION

Residents responded favorably to the introduction of an innovative iPad based curriculum for the orthopedic anesthesia rotation. According to the feedback and survey results, this was due in part to residents' better understanding of rotation goals from the beginning and the ability to recognize whether these goals were achieved by the end of the rotation. The syllabus provided on the iPad was the same as the paper one.

Residents also reported improved teaching by covering material not directly involved with case management, which was likely related to easier access (articles are organized into folders on the iPad), although the paper syllabus was similarly separated in the binder. From the standpoint of the institution, the main negative factor of the tablet based curriculum is the device acquisition cost of several hundred dollars and its possible loss, which has not occurred in the first six months of use.

The shared touchscreen, handwriting recognition, wireless connections, and data processing and recording capabilities make tablet computers an attractive tool for graduate medical education. The ORs in which residents worked have a traditional desktop computer and keyboard, with the electronic medical record and Web access, including digital editions of textbooks and journals. The iPad used in this study was not linked to the electronic medical record.

The opportunity to share knowledge provided by a tablet computer meets the need of the current generation of house staff which expects more than a static source of information like paper printouts of scientific articles. As residents complete the rotation, they submit content such as slide software presentations they think are relevant to the rotation. This is consistent with a learner-centered curriculum¹¹. The tablet device becomes an electronic repository of resident generated materials, which enables them to learn from unique, interesting cases their peers may have encountered. Furthermore, the content itself can be updated to include the most recent guidelines, giving the house staff an opportunity to be involved actively in their learning and learning from others, which helps in addressing several of the ACGME's six core competencies, particularly with regard to practice-based learning, improvement, and interpersonal communication skills.

The tablet seems to have brought several benefits to resident learning. These include stimulation of self-directed learning by the resident when not in the hospital. The iPad curriculum was readily accessible a few seconds after turning the machine on at home. Although a paper based curriculum is also in theory available at all times, the additional weight of a paper binder compared to the tablet can make it seem easier to be transported home. Other noteworthy benefits were the portability of large amounts of information into and out of the OR and a more dynamic interaction in the OR, as the device improved communication between faculty and residents. This communication is especially useful when the core faculty were unavailable to work with the resident because the tablet facilitated dialogue between the resident and the non-orthopedic anesthesia attendings.

The size of the tablet allows for mobility within the OR. House staff indicated in the written comments that having the ability to move the tablet around the anesthesia workspace made it a more ergonomically friendly technology than the large printed binder or the stationary desktop already in situ. Also, the resident entries into the iPad curriculum could also be useful to residents in other rotations. The next development steps for the iPad curriculum are to add a question bank, ACLS algorithms, and dosing protocols. We are now considering whether to use iPads for other rotations.

Another important feature that a tablet can provide is to add a social dimension to learning that is not available in current formats. Trainees can interact in real-time with other residents. For example, we expect that in the future users will be able to add, delete, rate, and provide feedback about articles and slide presentations to build a social education network to keep residents who have done the rotation updated on what is new¹². Individual learning styles vary, so having a variety of modalities available via the tablet seems to be advantageous.

Faculty expressed concern about the iPad potentially distracting the resident from the patient care. Junior residents (first 6 months of anesthesia training) are asked to be mindful when using the iPad during the intraoperative period. A recent study found that although anesthesia providers read during a significant percentage of the maintenance period in many cases (even when being observed), reading occurred when workload was low and did not appear to affect vigilance¹³. Ongoing vigilance during any iPad use or with any other potential distractive is essential.

LIMITATIONS

The study was not a double-blind, randomized trial, with the control group of residents receiving a printed binder. Our study has limitations such as not accounting for confounders. Examples of such confounders include: other aspects of the resident experience such as a change during rotation (e.g., new orthopedic surgeon); the case mix (e.g., fewer joint arthroplasty being done); or the patient's care (new clinical pathway). No such changes occurred during the study period.

FUTURE STUDIES

Although reading a body of texts is easier with a tablet computer than with a smartphone, differences between small laptops and tablets including Android® based products may fade over time. As a result, more studies are needed to evaluate some objective measures to determine the difference between paper and iPad curriculum. Such measures could include estimation on how many of the articles residents read, giving pre- and post-tests to determine how much knowledge improved, how many hours per day residents used the curriculum provided on the iPad versus the binder, and how many times they interacted with other residents or attendings using the

curriculum. This would help to assess which aspects and features of mobile computing technologies are particularly good for enhancing learning, and whether specific training such as sessions on how to annotate and draw on the iPad would be useful (apps are available, which allow the user to highlight and make notes on PDF files).

CONCLUSION

Medical educators today have new tools that could transform modes of traditional medical education. Education is becoming less and less anchored to paper. This is the first report of an iPad based curriculum for graduate medical education.

Residents responded favorably to the introduction of this innovative iPad based curriculum for the orthopedic anesthesia rotation. The tablet appears to offer a more user-friendly and interactive curriculum than paper, allowing the trainee to directly view relevant data, articles, or images. More studies are needed to show how such mobile computing technologies can enhance learning, especially since residents work at multiple locations, have duty hour limits, and there is a continuing need to document resident learning in the six ACGME core competencies.

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